On the quantification of heteroatoms in carbon nanotubes at bulk and local scale

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Abstract

Various functionalization methods for carbon nanotubes have been proposed over several years now. [1] Among those, substitutional doping and intercalation are methods that can be done with atoms of one same element distributed within the bulk carbon nanotube sample or incorporated as part of the tubular structure. [2] Their presence induces changes in the physical properties of the materials that are very desirable for applications but to make this effective, a proper understanding of the heteroatom content and distribution should be controlled. In a different context, the advances in sorting and purification of single-walled carbon nanotubes (SWCNTs) of the last years opened several possibilities for their applicability. SWCNTs with on-wall functionalization are nowadays produced with different methods. However, sorting and purification of functionalized materials in general has been scarcely explored. Therefore the understanding how the energies of charge carriers and lattice vibrations are modified, among other effects due to the presence of heteroatoms and defects is still elusive despite many years of worldwide efforts. I will show our progress on establishing the prerequisites for studying the rich low-dimensional physics of substitutionally doped SWCNTs as an example. [3] It will be discussed how metallicity-sorting combined with high energy spectroscopy techniques can nicely disentangle the characteristic density of states of doped SWCNTs with different doping levels unambiguously. We will discuss the changes in the site selective electronic structure of other various examples of functionalized SWCNTs. [2-4]

References

[1] P.Ayala, R. Arenal, A. Loiseau, R. Arenal, A. Rubio, Rev. Mod. Physics, 82 (2010) 1843
[2] C.Reinoso, C.Berkmann, L.Shi, A.Debut, K.Yanagi, T.Pichler, P.Ayala, ACS Omega, 4 (2019) 1941
[3] C.Reinoso, L.Shi, O. Domanov, P.Rohringer, T. Pichler, P.Ayala, Carbon, 140(2018)259
[4] L.Shi, P.Rohringer, M.Wanko, A. Rubio, S. Waßerroth, S. Reich, S. Cambré, W. Wenseleers, P. Ayala, T. Pichler, Phys. Rev Materials, 1(2017)075601